LONG FORM VIEWING
EXPERT OBSERVER QUESTIONNAIRE SUMMARY

TECHNICAL EXPERTISE/BACKGROUND: engineering (e.g. electrical, radio, allocations, communications, motion picture and video) Henderson said "none".

ACATS ASSOC.:	PSWP6	SSWP2	TECH SUB GP	FCC	OTHER
	5	11	4	28	28

Overall **audio** quality comments:
"Excellent": 26; "Very Good": 16 "Good": 8 "Very Impressive": 3

"superb, incredible, equal or better than movie theater, fine, details stand out, overall excellent, excellent surround sound, clear distinct, picks up sound normally missed, great, had a live feel to it, super, fidelity excellent, very complete, the whole is greater than the sum of its parts, fantastic, very sharp sound, no distortion or interference, very realistic ... hyper-real, satisfying, generally very good, satisfactory: a bit artificial and mechanical".

Overall **video** quality comments:
"Excellent": 25; "Very Good": 14 "Good": 8 "Sharp/Clear": 6

"great, detailed, outstanding, images seem very real, excellent on small screen, poorer on sports especially kayak, very impressive better depth, almost 3-D, remarkable color, very fine, great on direct view, good reproduction, superb, satisfactory for home theater, no artifacts, super, fantastic, very highly defined, excellent clarity and focus range, no problems, noticed projector convergence problems, noticed beam depletion (3) [a camera artifact], fewer artifacts than in the past, no scan lines, crystal clear, quality improvement significantly noticeable, falling snow, Kayak and golf ball had artifacts".

Overall **audio** <u>**with**</u> **video** quality comments:
"Excellent": 18; "Very Good": 7 Good": 9 "Very Impressive": 2

"good realism, theater-like, video good - audio excellent, audio so good it captures all my attention, good audio added to the enjoyment of video, near real-life experience, ultra, audio makes the pictures excellent, powerful rich viewing experience, an enhanced experience, quality matches, a great deal better than 1993 & 1994, content eclipses quality judgment, amazing experience, excellent entertainment, much better than regular TV, stereo imaging not well planned, best I've experienced, no problems, audio enhances video (2), extraordinary, excellent entertainment, excellent match".

Did the Red October film clip seem **better: 22 ... (bet. better & same: 4) same 26** ... or **worse 10 ...** as a typical film projection? Specific reason?
"less jitter, poor contrast ratio, projector not as good as film".

Any comments on differences between the projection versus direct view images?
Projector: "soft": 11 "less contrast": 4 "brighter": 2
"vertical striations, liked projector when picture was dark did not have usual hazy aspect we suffer, prefer lighter projector, lighter contrast and detail, fuzzy, poor color convergence, good for theater, more fluid than CRT, color differences among displays, good details, washed out blues and whites, good mixed colors, 20% less definition, less resolution, unfocused, color more accurate, less detail".

Direct View: "sharper": 16 "better contrast": 7 "darker": 3 "3-D": 3
"better defined, preferred, clearer (4), stronger, solid, better (3), superior, much better, more definition, glad a CRT was provided, crisper (3), color differences among displays, mostly for home, perspective is better, off in color otherwise crisp and clear, less noticeable quantization noise, better dynamic range, significantly sharper, colors more brilliant, black level better (2), strongly prefer, better focus, better depth of field, more true to life, liked CRT when picture was bright, vastly superior in contrast and freedom from display artifacts"..

This is to be the **US** and possibly North American high definition **television standard**; please comment:
"incredible that 6 MHz can produce this audio and video quality, good (2), very usable (2), very good performance, yes - industry and public should be pleased, very good standard especially when compared to past systems with defects, let's get on with it, wonder if consumers will value the quality, it will sell, question expense versus utility, go for it, will be hard to beat, to show capability you need bigger than 28" screen, highly recommended, yes but NTSC is entrenched, this is an improvement and expect it to improve more, fine, good choice, substantial improvement for big screens, great, good luck getting broadcasters to spend the money, picture clarity will make a good sell, concerned about the expense, good quality, hope to see it happen in my lifetime, the sooner the better, acceptable, would love to own an HDTV someday, looks good to me, very detailed, 3-D pictures, how much money. yeah - get it on the air, implement it quickly, good, how big to get best picture, acceptable, very acceptable, can introduce refinements to coder design over time, OK, aye, great with a chance to improve to 1080 progressive scan, should be approved, good but further comparisons are needed to further evaluate, I can't wait, where and when can I buy one, it met expectations, good performance, I anticipate consumer enthusiasm, adopt it ASAP to maintain US. lead, system well suited for adoption, agreed, go for it, superb, excellent standard (2), can't wait to have it in my home, can only get better, only necessary for large screens, yes, the right choice, we have a winner for the next thirty years or so, why not, it appears that the signal standard is better than the display technology."

General Expert Observation & Commentary (**EO&C**):
"overall very good (2), unobservable interlace artifacts, projector and CRT much better than NTSC, outstanding especially "Kingfisher" and "Ray Charles", the music and snow was surreal, no noticeable problems, jittery effect of baton in Mozart, very very few artifacts (2), wonderful sound especially with classical music, optimal sound and image quality are quite exceptional, distortion in bass on one clip, story content of Red October eclipsed my quality considerations, very good pictures and sounds, concerned about sports, no major errors, reduced contrast in darker scenes and colors, bright blues non-existent in many scenes, conductors baton had movement problems, images darker than I like generally, want bigger direct view displays, close to 3-D, film emotes feeling ... electronic camera appeals more to the senses, system will give a big boost to pay-for-view (concerts), none observable at typical viewing distances, excellent image quality, no important visible artifacts color seemed slightly off, want higher resolution video, very good audio and video but not sure it's significant enough to justify expense, projector exceeded expectations, quite impressive, mild quantization noise especially in darker scenes, blocking in Kayak and BMW, great job, need better refreshments, the limiting factor is clearly the display, a great achievement, will it be global, a wonderful result.

Attached is a table of potential digital audio artifacts, most can be applied to video. It can be used as a guide, if you wish, for general EO&C comments. Please describe any **errors noticed** over the entire viewing and listening session.

"two to three video tape errors otherwise perfect, dropouts (2), minor blocking error in sports, impressed by absence of blocking quantization, small quantization noticeable in weeds on railroad, very few noticeable artifacts, none recognized, no worse than from uncompressed digital sources, one white spot visible during classical music, quantization more than adequate, white spots noted, quantization noise in outdoor scenes, film grayness disturbing, noticed breakups in basketball scene, quantization defect noticed in nature video, impairment on fast motion, lost high frequencies and blues, in high-contrast fast-motion snow and conductor baton especially, audio freeze twice & video once (2), overall color effect seemed shaded or darker than TV, quantization defects in still portion of moving images, some loss of high frequencies, very slight quantization noise visible but not important, none observable at typical viewing distances, some loss of resolution on moving objects, something strange with Palmer's golf ball after it landed, motion artifacts if I looked hard such as fast pass on cobblestones, water spray etc. not objectionable.

POPCORN WAS:	EXCELLENT	GOOD	FAIR	POOR	BAD
	12	15	3	1	0

The 32 abstentions should be counted as "excellent" since this answer was pre-voted for everyone, making 44 of 63 responses of "excellent" (or 59 of 63 responses of "excellent' or "good"). Comments included "my boss arranged for the popcorn" (voted "excellent"), "did not indulge", and "sodas were warm".

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To: Bronwen Jones, ACATS Long Form Test Director.

From: Jim Gaspar

Date: 10/23/95

Subject: Long Form viewing

These are just a few notes on the test materials and displays used in the Long Form viewing that may help to interpret some of the responses on the questionnaires.

I matched the 2 direct view Sony monitors independently of the light valve projector since the technologies are miles apart in terms of transfer characteristics and spectral profiles; the monitors were very closely matched to each other for all but the 10 am 10/17/95 viewing. Prior to the 10 am viewing I retouched the convergence of both monitors and forgot to restore the fine tuning color adjustments made on the previous day -- one monitor was skewed toward red and the other toward green for that session.

There are 2 audio dropouts (~ 1/2 sec.) and a momentary picture freeze on tape #1 of the Long Form test materials. These occurred somewhere in the recording path when the test tape was made since the playback recorder does not register any signal dropouts at the points where the errors occur There is no telling at this point what caused them but they most likely occurred during the dubbing process since the test tape was a copy of the ATTC master that was error free.

There is also a momentary audio dropout on "Hunt for Red October" that is a videotape flaw since a "mute" indication is registered on the playback recorder at precisely the same timecode in the playback of the program.

A considerable portion of the video in the "Kingfisher's River" segment was shot with the shutter active on the CCD camera. This produces a cel animation discontinuity effect (no motion streaking) that is highly visible in the daylight snow falling sequences. I have received several questions about the origin of this effect and want to make it clear that this is not a video compression artifact.

Several "white spots" have been noticed in the 2 musical sequences that I attribute to spectral reflections from the musical instruments that cause beam depletion in the tube cameras used in these programs. Again these are not compression or digital dynamic range limitation problems.

I hope you find these comments useful and thank you for the excellent job you did in conducting the Long Form tests.

Section 15.

COMMENTS BY GRAND ALLIANCE ON TEST RESULTS

Introduction

The objective and transmission tests conducted by the Advanced Television Test Center are intended to provide data on system performance that complement those called for under the Digital-Specific Test Plan, the Cable Television Transmission Test Plan, the Video Subjective Test Plan, and the Audio Subjective Test Plan.

The following sections provide comments by the Grand Alliance concerning the results of tests conducted by the ATTC under the Objective and Transmission Test Plan. When appropriate, however, the comments draw the reader's attention to relevant results generated in response to the other Test Plans.

Video Performance

Objective characterizations of video performance show favorable results. In 1080I mode, the system matched, or bettered, the Advisory Committee's theoretical Target Specifications on 7 of 12 resolution measurements. In 720P mode, the system matched, or bettered Target Specifications on 9 of 12 resolution measurements. It should be noted that some of the apparent shortfalls in 1080I performance reflect the fact that the system employed field-based vertical chroma filtering, while the theoretical Target Specifications make no provision for such filtering. It is to be expected that, had frame-based filtering been used, performance would have been more in line with Targets.

The excellent performance of the video subsystem is confirmed by expert observation as reported in the Report of the Task Force on Digital-Specific Tests (see Free Form Viewing) and by judgements by non-experts as reported in the ATEL report (see Basic Received Quality).

In both 1080I and 720P modes, the system performed within Target Specifications for video-captioning latency. In 1080I mode, the system met Target for video-audio latency but, in 720P mode, did not. The latter shortfall is not systemic; instead, it reflects the fact that the timing, which is completely programmable, was not optimized for 720P.

Transmission Performance

Transmission System Robustness

Performance of the transmission subsystem also was excellent. Of 18 Targets set by the Advisory Committee for transmission performance, discrete frequency performance, and peak-to-average power, all were met. The Grand Alliance believes that these results confirm that the transmission subsystem is well-suited to the needs of the terrestrial broadcast environment.

Interference to NTSC

Performance of the transmission subsystem in terms of interference to NTSC also was excellent. Of 12 Target Specifications established by the Advisory Committee, all but one were met. The remaining Target, that for the N+2 taboo, was missed only by 0.57 dB—an amount of little or no practical significance. The Alliance believes that these results confirm the ability of the system to co-exist with transmitted NTSC services.

With regard to upper adjacent channel ATV-into-NTSC issues, see the attached analyses (pages I-15-3 through 14).

Interoperability and Packetization Tests

The Grand Alliance accepts the report verifying compliance of the prototype hardware system with the ISO-MPEG standards and ATSC standards document with the following comments:

1. The Grand Alliance agrees with the Report's conclusions that the minor semantic violations discovered do not impact the audio or video quality or coverage area findings of the laboratory and field test plans.

2. As the Report speculated, the error in audio buffering was due to delay parameters improperly set in the audio encoder. The proper settings would have shifted some of the delay required for lip sync with video into the encoder. This will be corrected in the prototype hardware.

3. Other minor semantic violations cited by the Report have been identified as improper software settings in the transport system. These parameters are being updated to conform with the standard.

4. The Grand Alliance prototype hardware will be fully updated to address the compliance issues identified by the Report. This will ensure that future bitstreams distributed will be fully compliant.

Conclusions

The Grand Alliance is pleased with the performance of the system in tests conducted at the Advanced Television Test Center. The results of video measurements and tests confirmed that the system can deliver high-quality video for entertainment and other applications. The results of transmission tests verified the suitability of the system for use in the terrestrial broadcast environment, even in the mixed ATV/NTSC environment that will exist after the introduction of advanced television service.

Acknowledgments

The Alliance wishes to express its appreciation to the management and staff of the Advanced Television Test Center for their contributions to the development of the test procedures and for their hard work and diligence in carrying out the tests and in supporting other essential parts of the test program, such as the digital-specific tests and the video subjective tests. We further wish to acknowledge the long hours put in by the ATTC staff to assure completion of testing in an expeditious manner and to commend their efforts in maintaining an accurate record of system performance. The Alliance also wishes to acknowledge the critical contributions made by the Expert Observers, who gave freely of their time and expertise to characterize the system. And, finally, the Alliance wishes to recognize the Advisory Committee and, in particular, Mark Richer, Chairman of SS/WP-2, for their effective management of the process.

Attachment

September 13, 1995

AN ANALYSIS OF THE ATTC UPPER ADJACENT A INTO N AUDIO INTERFERENCE TEST RESULTS

Introduction

In this note an analysis is presented of the ATV into BTSC Audio interference results from tests performed at the ATTC. It is presented in two parts: 1) interference due to ATV out-of-band spillover, and 2) the TV receiver adjacent channel response.

Test Data

The data taken on 24 television receivers at the ATTC was recorded in the form of D/U ratios for video Grade 3 rating and audio slightly annoying rating for the case of upper adjacent A/N interference. The audio test material consisted of "Glockenspiel", Harpsichord, and a man talking. No TV station type audio processing was used for audio modulation.

A median D/U for a video Grade 3 rating was calculated from the data to be -17 dB and for an audio "slightly annoying" rating to be -12 dB. Some individual TV receivers had close to those performance numbers.

Analysis

The attached Figure 1 has plotted on it the in-band and out-of-band spectrum taken from a spectrum analyzer plot made at the ATTC. For convenience in audio calculations the spectral density is shown with a resolution bandwidth of 30 kHz (which reduces the level of noise-like interference in each 30 kHz band relative to the 6 MHz band by about 23 dB). There is a 3 dB interference increase in level at the aural carrier. The aural carrier was 13 dB lower than the visual carrier, thus placing the aural carrier at -68 dBm with the visual carrier at -55 dBm. The out-of-band ATV spectrum level was 56 dB lower than the in-band spectrum level thus placing each 30 kHz interference band at -122 dBm (-43 dBm - 56 dB -23 dB = -122 dBm). The TV receiver tuner degrades this value by about 4 dB to -117 dBm. The aural channel interference is 3 dB worse at the aural carrier, as mentioned above, making the aural channel noise level a value of -114 dBm. Thus the aural carrier to noise ratio in a 30 kHz band is -68 dBm/-114 dBm = 46 dB. This value is used in the next step.

Determination of Audio S/N from Aural C/N

To calculate the audio S/N the following steps are taken:

Aural carrier/noise = 46 dB (in 30 kHz band ,i.e., ±15 kHz AM sidebands)

FM improvement over AM

$$= \sqrt{3}\ fd/fa$$
$$= 1.73 \times 25/15 \approx 9\ dB$$

Audio S/N (without 75 μsec de-emphasis) = 55 dB
with 75 μsec de-emphasis = 68 dB
Note: BTSC stereo audio S/N is essentially the same as monophonic S/N because of the aggressive dbx companding in the L-R channel.
The SAP channel is about 4 dB poorer, or 64 dB audio S/N.

Effects of Buzz

Intercarrier sound receivers typically sacrifice sound performance in favor of chroma channel performance in order to reduce the 920 kHz chroma/sound beat in the luminance to acceptable levels. The typical consequence is a degradation of the above 46 dB aural C/N in a 30 kHz band to 43 dB. The audio S/N is then 52 dB without de-emphasis and 65 dB with de-emphasis. Because of video contamination (buzz) the de-emphasis is less effective with the typical result being about 62 dB for the audio S/N. When determining threshold of audibility (TOA) by switching the interference on and off, buzz, receiver noise, and room noise ,however, are not important factors. Therefore 73 dB audio S/N is considered the TOA for this test data.

The remaining question is -- what is Grade 3 audio S/N?

Many factors are involved:

1) Maximum sound pressure level (SPL),
2) Room noise,
3) Age of listeners,
4) Type of program, and others.

Noise impairment tests performed several decades ago and reported to the CCIR are reproduced in the curve of Figure 2. Grade 3 is at about 63 dB S/N weighted. (This is to be compared with the 65 dB calculated above.) The maximum SPL was 83 dB. Room noise was not mentioned but the listening set-up was considered good and used large loud speakers, etc. Grade 4.5 (TOA) is about 70 dB S/N weighted. (This is to be compared to 68 dB S/N calculated above.)

ATTC Listening Conditions

The ATTC tests evaluated in this report used the TV sets' own small side-firing speakers with an audio reproducing level allowing normal conversation. Maximum SPL was not measured but was probably about 60 dB SPL. Room noise was not measured but was probably about 30 dB SPL (air-conditioning noise?) resulting in a 30 dB dynamic range in the room. This is to be compared to about 60 dB for the listening conditions resulting in Figure 2.

TV Receiver Adjacent Channel Response Characteristics

Adjacent channel characteristics of TV receivers using the typical characteristics of two types of receiver sound I.F. design are shown in the next two Figures 3 and 4. Figure 3 summarizes the adjacent channel findings using a 4.5 MHz ceramic I.F. filter, and Figure 4 a double-tuned L-C I.F. filter typical of early and some current BTSC Stereo (and SAP) receivers. The interfering ATV spectrum total average power is shown at the level of the Grade 3 audio median receiver results of a D/U = -12 dB. (D being the peak NTSC power and U being the ATV average power.) The ATV spectrum is also shown at a resolution bandwidth of 30 kHz (twice final audio bandwidth) so that ultimate C/N FM carrier values may be read directly. The FM improvement and de-emphasis factors further improve on the C/N to produce the audio S/N, i.e., C/N plus 9 dB plus 13 dB = S/N.

Each 4.5 MHz I.F. filter has substantial response in the adjacent channel which when presented to the receiver limiter results in the spillover spectrum shown. However, real receivers have a limiter sensitivity which varies at least 10 dB. An in-house Zenith test on several receivers of various makes showed a spread of 20 dB in overall FM threshold performance). It is expected that intermodulation in the tuner will add to the problem

Shown on Figures 3 and 4 are two audio S/N values corresponding to the two 4.5 MHz I.F. filters. These values can be poorer than the S/N values shown by the 10-20 dB spread factor mentioned above and potentially reach FM threshold which produces a crackling type sound. Indeed, some of the subjective comments identified that type of interference.

Above FM threshold, the SAP S/N should be 4 dB poorer than BTSC stereo, which is consistent with the subjective findings.

Ceramic Filter I.F. Performance

Figure 3, using the characteristics of the 4.5 MHz ceramic I.F. filter, shows a spectrum spillover at a level of -119 dBm caused by the limiter action on the receiver filtered adjacent channel ATV spectrum. This spectrum spillover level is comparable to the TV receiver noise of -120 dBm. The original ATV spectral spillover of -114 dBm (see above at the beginning of this analysis) must also be included. The three combined result in a level of -112 dBm which when compared with an aural carrier level of -68 dBm (V/A = 13 dB) becomes a C/N of 44 dB and an audio S/N of 66 dB.

Double Tuned L-C I.F. Performance

The double-tuned filter has considerably more response into the adjacent channel, as shown in Figure 4. Limiter action on the resulting filtered ATV spectrum produces a noise level in the FM channel of -106 dBm which predominates over receiver noise and the original ATV spectral spillover. The audio S/N becomes 60 dB.

Other Variables

As mentioned before, FM thresholds have been observed to vary by 20 dB. A principal factor in that variation is that some TV receiver designs are not meant for use in fringe area reception with compromises in receiver gain and tuner noise figure resulting in increased susceptibility to A/N interference beyond that analyzed above.

Conclusion

The TV receiver response to adjacent channel interference is the principal audio interfering mechanism and not the ATV out-of-band spectrum spillover present during the ATTC tests.

4

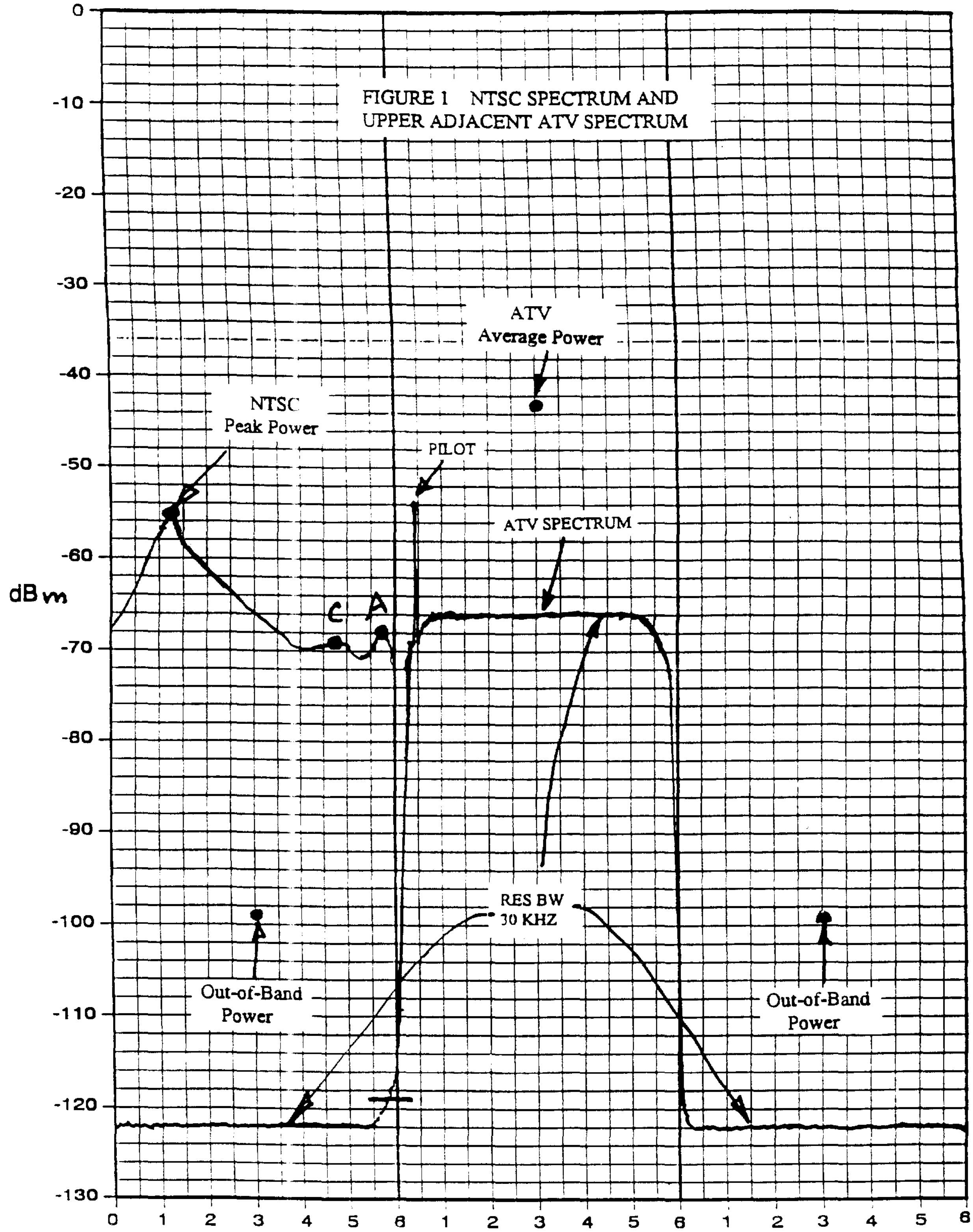
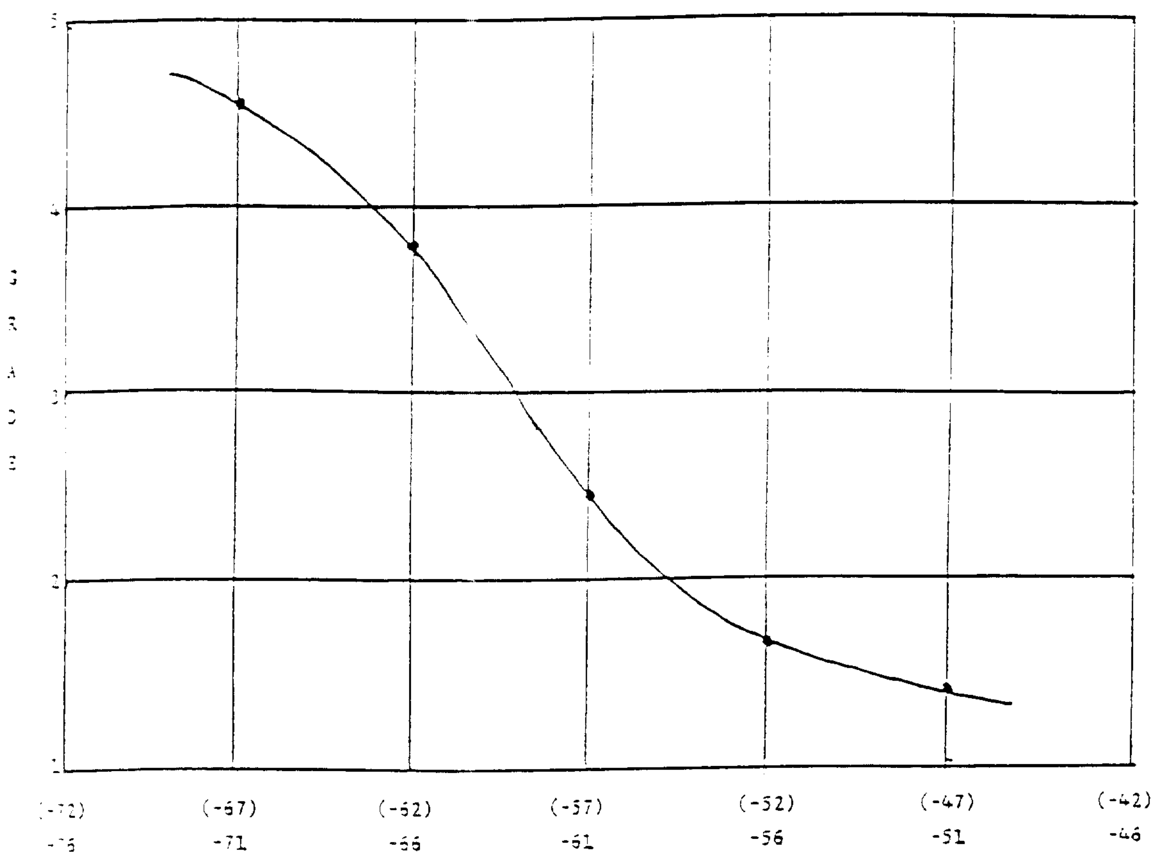


FIGURE 1 NTSC SPECTRUM AND
UPPER ADJACENT ATV SPECTRUM
ATV
Average Power
NTSC
Peak Power
PILOT
ATV SPECTRUM
C
A
dBm
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
RES BW
30 KHZ
Out-of-Band
Power
Out-of-Band
Power
0 1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6

5

FIGURE 1 AUDIO IMPAIRMENT TEST RESULTS
TAKEN FROM CCIR REP. 493-3



NOISE LEVEL dB
(UNWEIGHTED)
WEIGHTED

MAXIMUM LISTENING LEVEL 83 dB SPL

<u>IMPAIRMENT</u>

5 Imperceptible
4 Perceptable, but not annoying
3 Slightly annoying
2 Annoying
1 Very annoying

September 13, 1995

AN ANALYSIS OF UPPER ADJACENT CHANNEL A TO N CHROMA/LUMA BEAT AND CHROMA NOISE/DESATURATION INTERFERENCE

During the tests of ATV-into-NTSC upper adjacent channel interference on the 24 television receivers at the ATTC, expert observers noted the presence of a fixed diagonal stripe beat pattern, more or less visible during camera panning. Depending upon the D/U ratio, streaky noise like impairment was noted accompanied by a reduction or complete loss of color.

To understand the mechanisms behind the above observations, the adjacent channel response characteristics of typical color television receivers are developed with regard to chroma channel performance.

Receiver Characteristics

The chroma channel response is the combination of the cascade of the responses of main (44 MHz) I.F. of the SAW filter type, the 4.5 MHz intercarrier sound trap of the piezoelectric type, and the chroma takeoff bandpass (or modified highpass) filter. This is shown in Figure 1. These three responses are shown plotted relative to the visual carrier of the NTSC R.F. channel. (The I.F. response is shown as the equivalent R.F. response.) All three responses are adjusted to crossover at the 3.58 MHz color subcarrier frequency and the level in dBm is for the peak chroma for 100% saturated red as transmitted when the peak visual carrier sync is -55 dBm (weak signal) at the receiver antenna terminals. The overall response which is the cascade of the three responses is shown as the dotted line curve. It is seen that a significant response hump exists between the associated sound and adjacent picture frequencies which is only 12 dB lower than the chroma channel center frequency level.

Figure 2 shows the cascade response of Figure 1 with the ATV spectrum (with pilot) at a spectral density of 30 kHz resolution bandwidth. The median receiver (of 24) in the upper A to N adjacent channel tests performed at the ATTC had a Grade 3 performance when the D/U ratio was -17 dB. Figure 2 shows that condition. The resulting spectral interference hump with superimposed pilot is seen to have maximum value near the pilot frequency of approximately 5.05 MHz (with respect to the lower channel visual carrier frequency. The total r.m.s. value of the interference is approximately -62 dBm.

Color AGC

The color automatic gain control measures the color burst level (after time gating) and regulates the color difference output level of the chroma amplifier for a consistent matrixing with the luminance component which is regulated by the main I.F. and Tuner AGC. The color burst level (shown at -79 dBm) is contaminated with interference at -62 dBm, so the output color level is reduced by approximately 17 dB, considerably desaturating the color image. This action takes place well above the color killer threshold which is shown with a typical range of -102 dBm to -107 dBm.

Receiver Noise

Also to be noted is the contribution of the receiver's own noise at a level of -97 dBm and the noise like spillover spectrum power from the adjacent ATV signal at a level of -93 dBm resulting in an overall luminance noise level (referred to the antenna terminals) of -92 dBm. This level together with the peak visual power of -55 dBm results in a C/N ratio of 37 dB, not too far from a Grade 3 image as determined by the expert observers for this test.

Fringe Area Performance

Not all television receivers are designed to operate or to be sold in fringe areas (-55 dBm) and consequently the equivalent receiver noise level may increase by as much as 20 dB. (What actually happens is a lack of overall gain for weak signals.) In this case additional color desaturation may take place.

Variations from receiver design to receiver design will modify the above analysis. Trap widths and depths, associated sound as well as adjacent picture, together with I.F. filter design variations can further degrade (or improve) the performance.

Conclusion

What this analysis shows is that the typical color television receiver response into the upper adjacent channel is a substantial factor in explaining the test results of the A to N upper adjacent channel interference condition. Chroma noise and considerable color desaturation are expected. Also spillover spectrum from that ATV signal is a substantial factor in determining Grade 3 performance.

Finally, chroma noise is accompanied by a color beat caused by the pilot which, in this analysis, is shown as stronger than a saturated red. The visibility of this color beat (≈1.5 MHz) and the underlying luminance beat (≈ 5.05 MHz) may be minimized by precise frequency offset between adjacent NTSC and ATV carriers as suggested by the chief scientist of the ATTC. The color noise and color desaturation problems remain, however.

[ATTC Note: See pages I-14-67 through 69, for further background.]

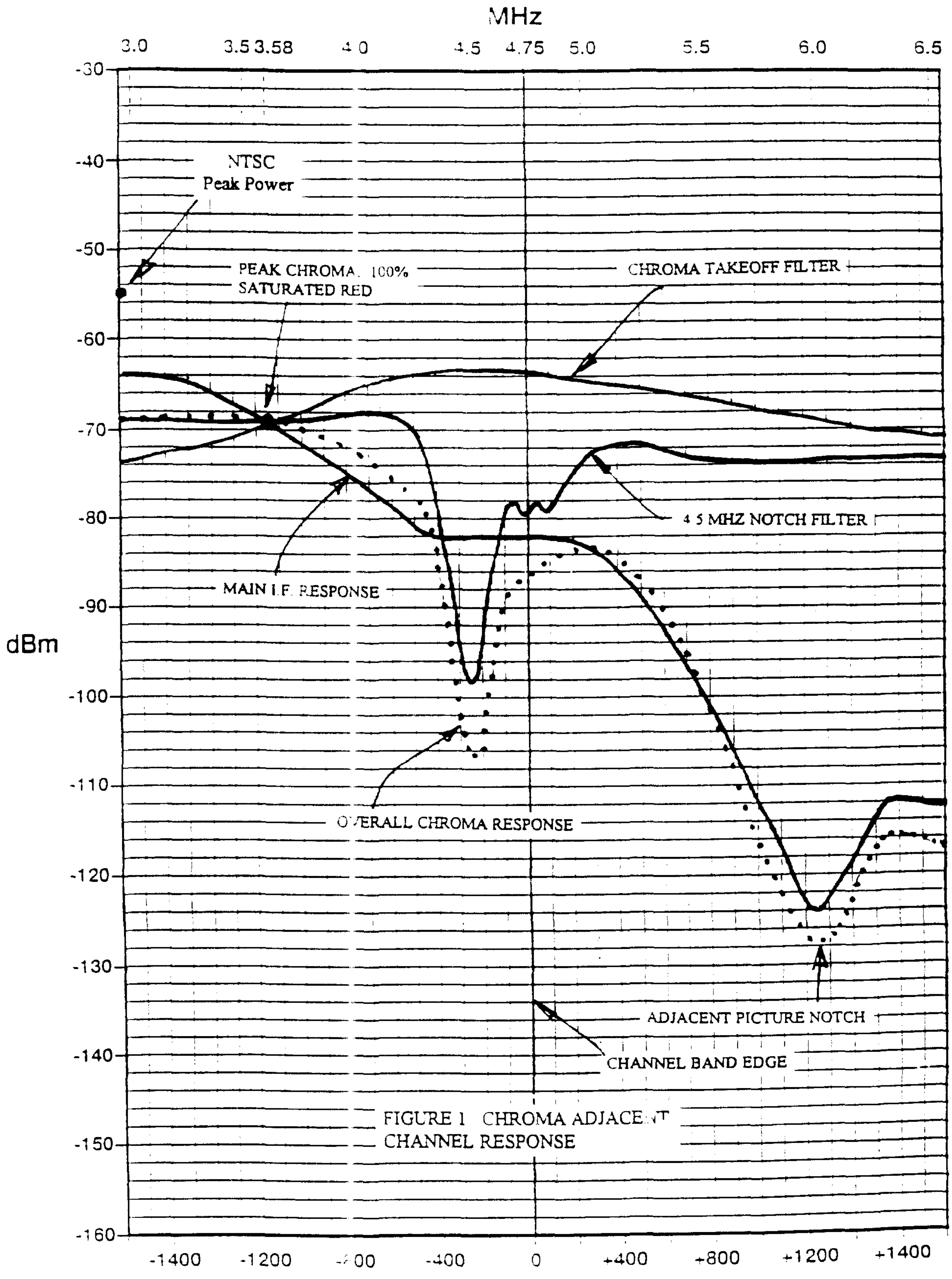


FIGURE 1 CHROMA ADJACENT CHANNEL RESPONSE

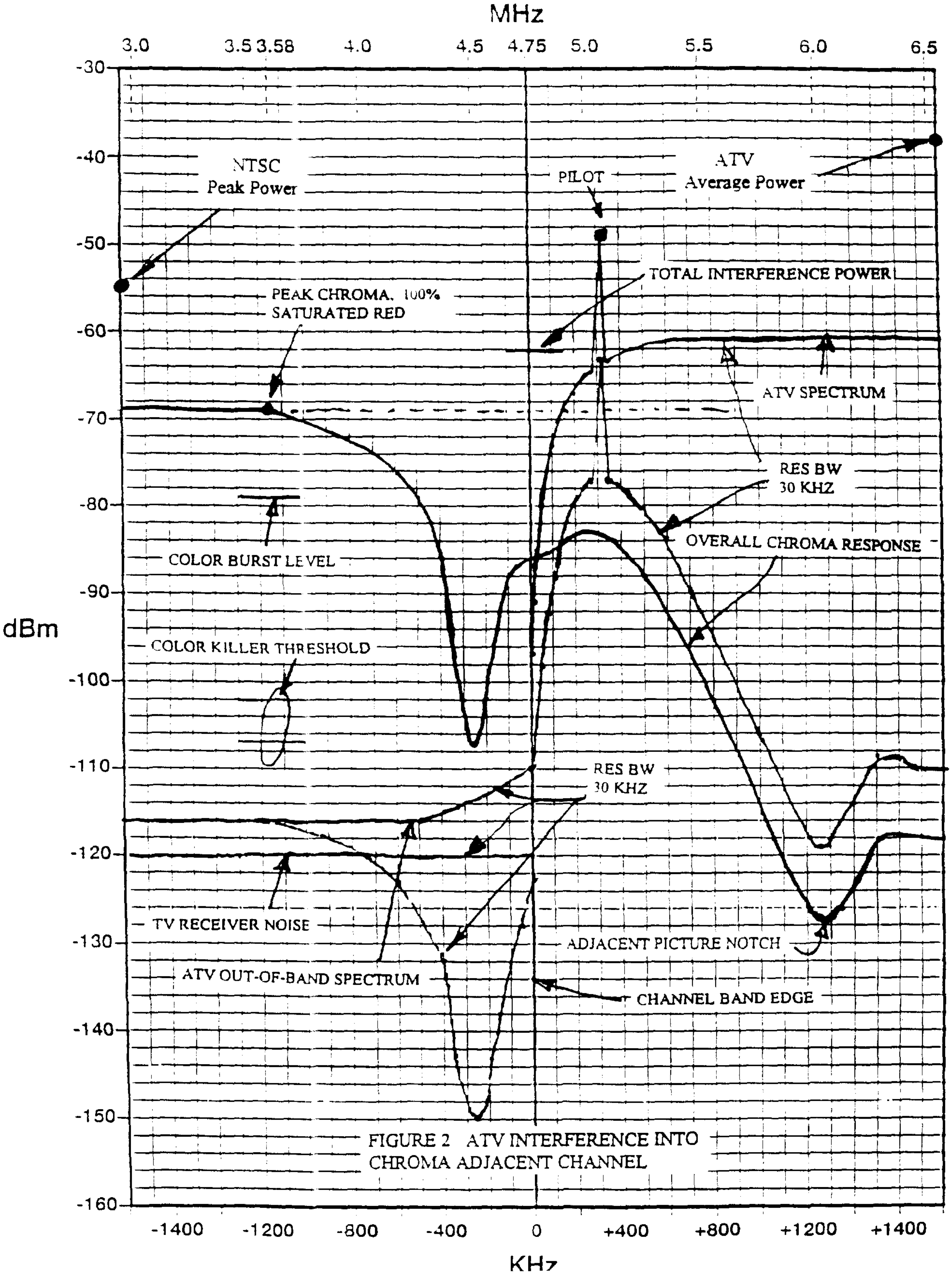


FIGURE 2 ATV INTERFERENCE INTO
CHROMA ADJACENT CHANNEL

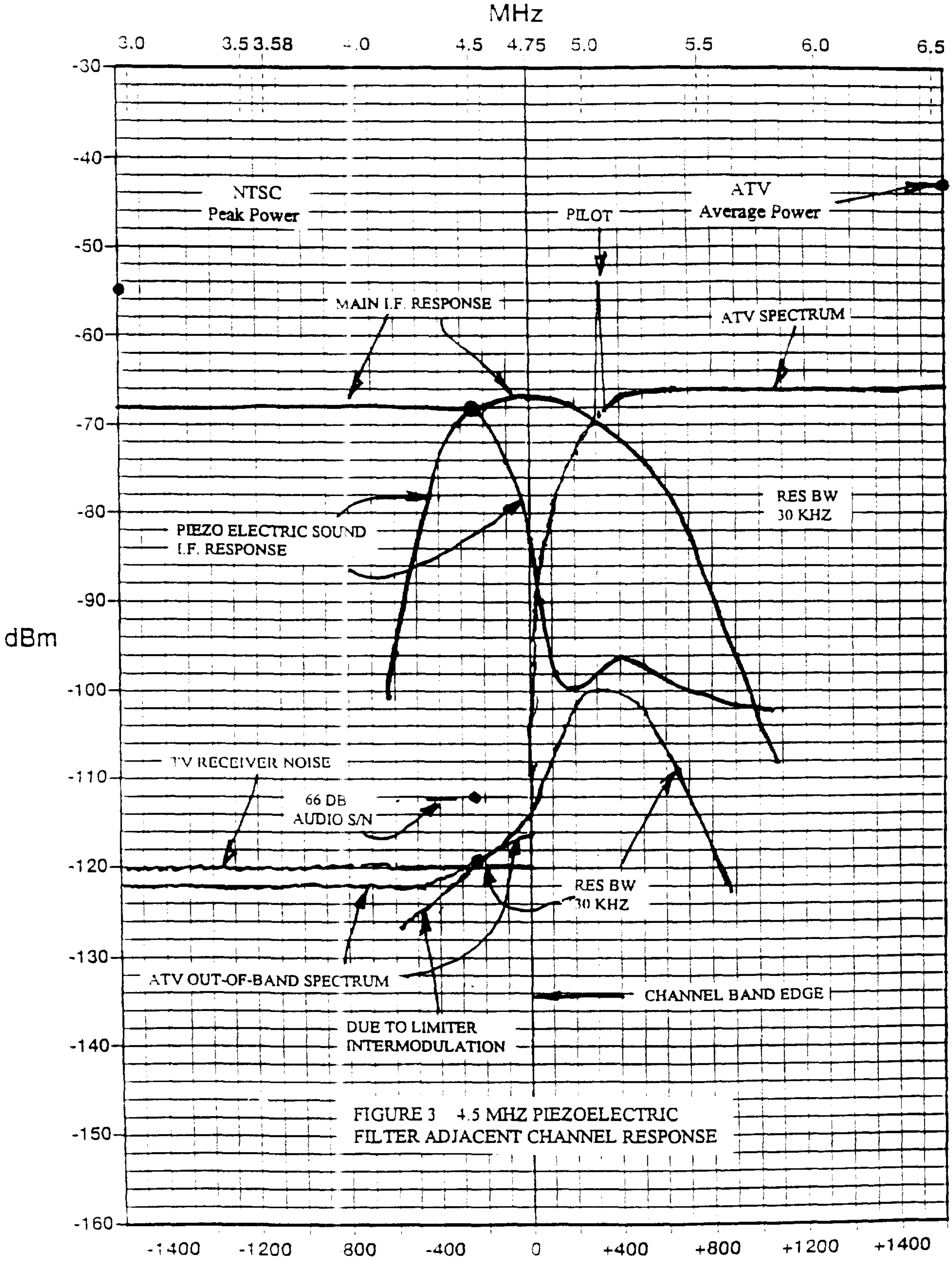


FIGURE 3 4.5 MHZ PIEZOELECTRIC
FILTER ADJACENT CHANNEL RESPONSE

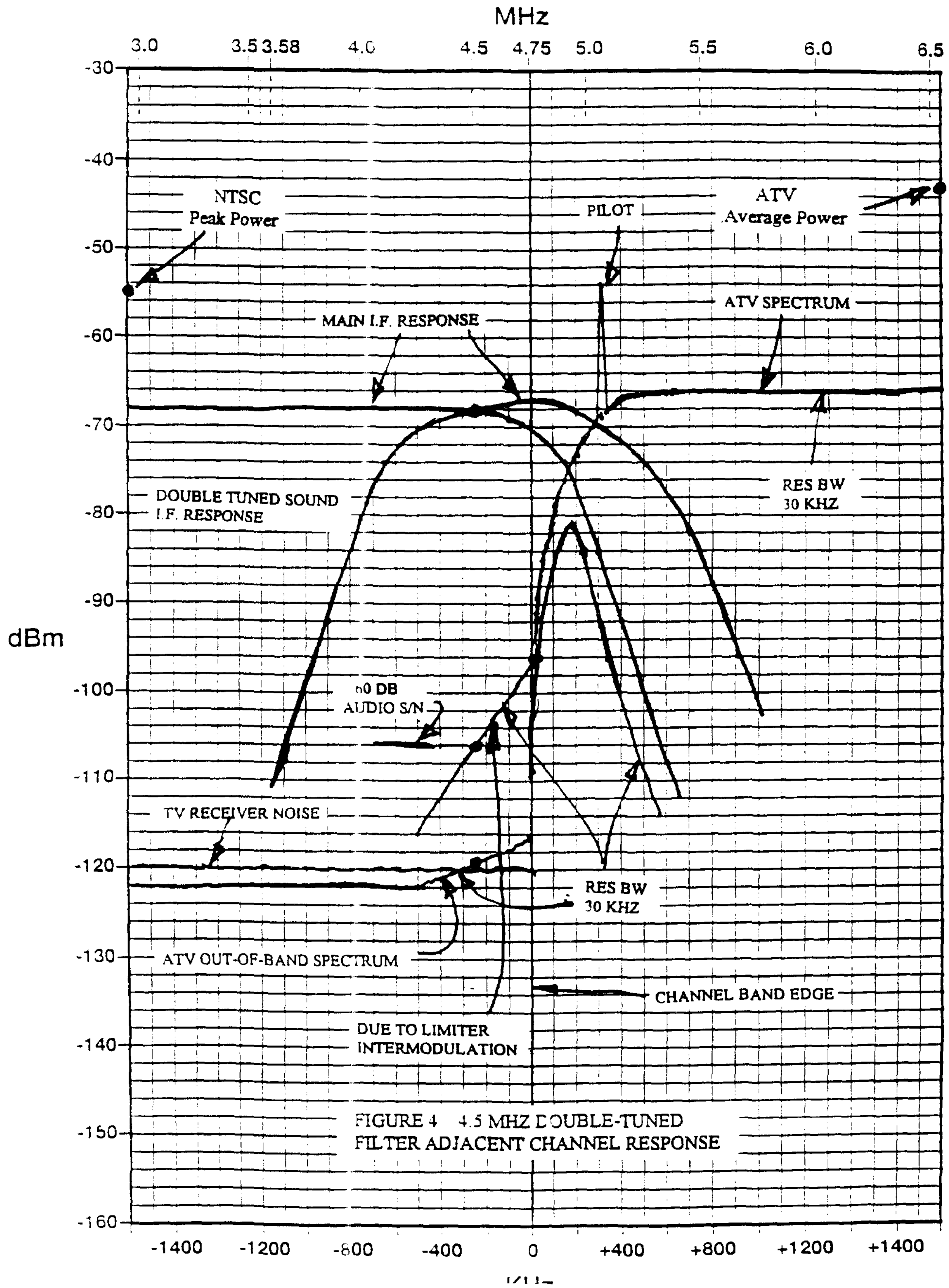


FIGURE 4 4.5 MHZ DOUBLE-TUNED
FILTER ADJACENT CHANNEL RESPONSE

APPENDIX

COMPARISON OF GRAND ALLIANCE
TEST RESULTS TO FIRST ROUND TEST RESULTS,
TRANSMISSION SUBSYSTEM TEST RESULTS,
AND ACATS TARGET VALUES

Co-Channel Interference into NTSC

ATTC Test #	Description	Desired Power	Sub Test	Desired to Undesired Ratio (dB)				
				Best Result 1st Round		Zenith (8VSB) Bakeoff Value Measured by ATTC	ACATS Target Value	Grand Alliance Value Measured by ATTC
16	Co-Channel ATV/NTSC	M	TOV	46.95	2	NITP		51.27
			CCIR3	NITP		NITP	<36.5	33.07
16	Co-Channel ATV/NTSC	W	TOV	46.41	2	48.54		47.74
			CCIR3	NITP		33.80	<36.5	33.81

1 = Digicipher, 2 = DSC-HDTV, 3 = AD-HDTV, 4 = CCDC
NITP = not in test plan
ACATS Target Values are not available for each Subtest.

Co-Channel Interference into ATV

ATTC Test #	Description	Desired Power	Sub Test	Desired to Undesired Ratio (dB)				
				Best Result 1st Round		Zenith (8VSB) Bakeoff Value Measured by ATTC	ACATS Target Value	Grand Alliance Value Measured by ATTC
17	Co-Channel NTSC/ATV	M	TOV	0.20	3	NITP		NITP
			TOV*	NITP		NITP	<3.5	1.40
17	Co-Channel NTSC/ATV	W	TOV	0.50	3	2.07	<3.5	2.05
			POU	-3.51	2	NITP		1.36
			POR	NITP		NITP		0.61
			POF	NITP		NITP		0.61
			TOV*	NITP		NITP	<3.5	1.81
56	Co-Channel NTSC/ATV (Δ freq. offset)	W	TOV*	NITP		NITP	<3.5	1.88
18	Co-Channel ATV/ATV	M	TOV	15.79 †	1	NITP		NITP
			TOV*	NITP		NITP	<16.6	14.78
237	Co-Channel ATV/ATV (ΔDelay)	M	TOV*	NITP		NITP	<16.6	14.92
18	Co-Channel ATV/ATV	W	TOV	16.37 †	1	NITP		NITP
			TOV*	NITP		15.91 ‡	<16.6	15.27
237	Co-Channel ATV/ATV (ΔDelay)	W	TOV*	NITP		15.91 ‡	<16.6	15.17
264	Co-Channel ATV/ATV (Δ freq. offset)	W	TOV*	NITP		NITP	<16.6	15.33
265	Co-Channel ATV/ATV (Δ freq. offset ΔDelay)	W	TOV*	NITP		NITP	<16.6	15.15

* BER Method

† = Delay between ATV/ATV is arbitrary ‡ = eyes aligned - eyes offset method

Upper Adjacent Channel Interference into NTSC

ATTC Test #	Description	Desired Power	Sub Test	Desired to Undesired Ratio (dB)				
				Best Result 1st Round		Zenith (8VSB) Bakeoff Value Measured by ATTC	ACATS Target Value	Grand Alliance Value Measured by ATTC
2	Upper Adjacent ATV/NTSC	S†	TOV	-1.17	4	1.09		0.26
			CCIR3	NITP		<-0.91		-13.00
2	Upper Adjacent ATV/NTSC	M	TOV	-7.30	1	NITP		-2.09
			CCIR3	NITP		NITP		-13.03
2	Upper Adjacent ATV/NTSC	W	TOV	-12.15	1	-5.65		-1.95
			CCIR3	NITP		-16.17	<-12.5	-16.91

† In the first round and bakeoff, the Strong desired power level was -15 dBm.
In the Grand Alliance testing, the Strong desired power level was -25 dBm.

Note: The levels in this table are for interference to video. See the table on Page 22 for the corresponding levels for interference to BTSC audio, which were found to precede those for video in these tests.

Upper Adjacent Channel Interference into ATV

ATTC Test #	Description	Desired Power	Sub Test	Desired to Undesired Ratio (dB) Best Result 1st Round		Zenith (8VSB) Bakeoff Value Measured by ATTC	ACATS Target Value	Grand Alliance Value Measured by ATTC
4	Upper Adjacent NTSC/ATV	S	TOV	-30.62	2	NITP		<-22.98
			TOV*	NITP		NITP		<-23.18
4	Upper Adjacent NTSC/ATV	M	TOV	-37.42	2	NITP		-44.44
			TOV*	NITP		NITP		-44.44
4	Upper Adjacent NTSC/ATV	W	TOV	-42.12	2	NITP	<-43	-48.54
			TOV*	NITP		-47.05	<-43	-48.71
6	Upper Adjacent ATV/ATV	S	TOV	-24.29	2	NITP		NITP
			TOV*	NITP		NITP		<-17.58
6	Upper Adjacent ATV/ATV	M	TOV	-31.56	2	NITP		NITP
			TOV*	NITP		NITP		-39.32
6	Upper Adjacent ATV/ATV	W	TOV	-36.02	2	NITP		NITP
			TOV*	NITP		-42.86	<-37.5	-43.17

* BER Method

Lower Adjacent Channel Interference into NTSC

ATTC Test #	Description	Desired Power	Sub Test	Desired to Undesired Ratio (dB)				
				Best Result 1st Round		Zenith (8VSB) Bakeoff Value Measured by ATTC	ACATS Target Value	Grand Alliance Value Measured by ATTC
9	Lower Adjacent ATV/NTSC	S[†]	TOV	<-1.25	4	NITP		0.23
			CCIR3	NITP		NITP		-10.94
9	Lower Adjacent ATV/NTSC	M	TOV	-2.19	3	NITP		-0.77
			CCIR3	NITP		NITP		-12.04
9	Lower Adjacent ATV/NTSC	W	TOV	-6.89	2	-8.02		-5.92
			CCIR3	NITP		-17.95	<-14.5	-15.96

[†] In the first round and bakeoff, the Strong desired power level was -15 dBm.
In the Grand Alliance testing, the Strong desired power level was -25 dBm.

Lower Adjacent Channel Interference into ATV

ATTC Test #	Description	Desired Power	Sub Test	Desired to Undesired Ratio (dB)				
				Best Result 1st Round		Zenith (8VSB) Bakeoff Value Measured by ATTC	ACATS Target Value	Grand Alliance Value Measured by ATTC
11	Lower Adjacent NTSC/ATV	S	TOV	-31.41	2	NITP		<-22.94
			TOV*	NITP		NITP		<-23.18
11	Lower Adjacent NTSC/ATV	M	TOV	-38.81	2	NITP		-44.37
			TOV*	NITP		NITP		-44.46
11	Lower Adjacent NTSC/ATV	W	TOV	-43.17	2	-48.09	<-41.5	-47.61
			TOV*	NITP		NITP	<-41.5	-47.73
13	Lower Adjacent ATV/ATV	S	TOV	-26.55	2	NITP		NITP
			TOV*	NITP		NITP		<-13.35
13	Lower Adjacent ATV/ATV	M	TOV	-33.74	2	NITP		NITP
			TOV*	NITP		NITP		<-38.23
13	Lower Adjacent ATV/ATV	W	TOV	-35.21	2	NITP		NITP
			TOV*	NITP		-42.16	<-37.5	-41.98

* BER Method